



From Dietary Guidelines to Dietary Guidance?

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Authors' contributions

This work was carried out in collaboration between both authors. Author EC conducted the literature research, analysed the data and wrote the first version. Author MU designed the work. Author MU was responsible for subsequent reviewing and scientific editing, while author EC was the primary responsible for final content. Both authors have read and approved the final manuscript.

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ABSTRACT

One challenge is to make food consumption healthful and sustainable. Tools to achieve this include science-based documented dietary advice (here: 'dietary guidelines'), and policy-based initiatives and legislation (here: 'dietary guidance'). These two scientific and political tools operate independently, which may be counterproductive, especially if the future gives rise to high-impact scenarios of food crisis. This paper analyses, based on empirical trend data, the potential of dietary guidelines and guidance, and provides suggestions for these to align.

Trend-analyses and empirical data point out that dietary guidelines, although relevant, achieve limited uptake by the consumer. Scientists apparently lack the management tools and communication channels to effectively reach the consumer, and thus major changes are not expected. By contrast, emerging issues such as the obesogenic environment and climate change are likely to call for greater involvement of policy-makers.

This paper therefore advocates alignment of science and food policy. First, dietary guidelines, used for individual health promoting purposes, should be calibrated on global considerations. Guidelines on red meat consumption are recommended, as red meat consumption is a burden on both health and sustainability. Second, dietary guidance, used for global health and sustainability promoting purposes, should be calibrated on empowering the individual. Guidance in creating self-sufficient local food networks is recommended, as self-sufficient local food networks address both health and sustainability.

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ABBREVIATIONS

EGCG: Epigallocatechin Gallate; FDA: Food and Drug Administration; GMO: Genetically Modified Organisms; GSTM: Glutathione S-transferase mu; GSTT: Glutathione S-transferase theta; NGx: Nutrigenomics/genetics; WHO: World Health Organization.

1. INTRODUCTION

One current challenge is to make food consumption healthful and sustainable [1-3]; a responsibility shared by scientists, policy-makers (including legislators), the industry, and consumers [4,5]. Tools to achieve this include science-based documented dietary advice (here: 'dietary guidelines'), and policy-based initiatives and legislation (here: 'dietary guidance').

Scientists and policy makers operate independently, causing dietary guidelines and dietary guidance to trigger opposite effects [6]. For example, scientists may recommend dairy as part of a healthy diet, whereas policy-makers may impose taxes on it for reasons unrelated to consumer health. This is a counterproductive situation, in which science and policy are in a balance that fluctuates on trends and high-impact future scenarios. Examples of these trends and scenarios are scientific advances, changes in consumer behaviour, an increase in food-related diseases, food supply chain crises, climate change, and international conflicts. High-impact scenarios require early anticipation [7] by scientists and policy-makers, preferably operating in concert [6]. Knowing how is crucial to make food consumption healthful and sustainable in the long term.

This paper will first explain the current trends listed above, i.e. how science and food policy influence our diets now, and how these trends may evolve. Second, it provides practical suggestions for dietary guidelines and guidance to anticipate high-impact future scenarios.

2. SCIENCE

Current guidelines, such as "the Eatwell Plate" [8], are a weighted consensus of recommended intakes of foods, macronutrients, and micronutrients. These recommendations are based on evidence on the population level for an adequate nutrition and reduction of chronic diseases such as obesity, cardiovascular disease, type II diabetes, and some forms of

cancer. Convincing or probable protective factors are especially: fibre, vegetables, fruits, and fish [9-12]. Convincing or probable harmful factors are especially: red meat, salt-preserved foods, saturated and trans fatty acids [9-12]. The degree of evidence has changed over the years, but the common conclusions have remained valid [13].

In contrast to conventional nutrition research on the population level, future research may open the road to personalised dietary guidelines in order to reduce the risk of obtaining disease. Two scientific advances are nutrigenetics and nutrigenomics (NGx), i.e. crosstalk between the diet and gene expression. For example, it has recently been suggested that a protective effect of cruciferous vegetable intake on lung cancer only holds in individuals who are GSTM1-null and/or GSTT1-null [14]. Further, expression of colon cancer-associated genes could perhaps be altered by dietary components such as epigallocatechin gallate (EGCG), curcumin, and resveratrol [15-18].

Genetic expression differs per individual, so that NGx can lead to personalised dietary guidelines. However, it remains to be seen whether NGx and personalised nutrition will fulfil their technological potential [19,20], and whether they will be embraced by the consumer [21-23]. Thus, NGx and personalised nutrition could be one mechanism for science-based dietary guidelines to increase in efficacy, but its widespread implementation faces delay.

3. THE CONSUMER

Whereas science informs the consumer what a healthy diet entails, consumers make their choices on various grounds [24]. For example, while healthfulness of vegetables is well-recognised by half of the Dutch population [25], their median consumption has declined consistently over the past decades [26] to 120 grams by 2010, which is well under the target of 200 grams per day [27]. Meanwhile, consumption figures of unprocessed meats have shifted to

processed meats, and crisps are more widely consumed [28]. Disregarding guidelines for diet and health is typically caused by short-term personal motives such as a lack of time [29-31] and self-control [25,32]. Consumers also base their choices on direct foodborne effects and complaints, as exemplified by an increasing number of people who want to cut back on gluten (e.g. ~30% of American adults [33]). In summary, short-term personal motives modify the efficacy of dietary guidelines in preventing unfavourable dietary trends in the long-term.

One could speculate if, and how the scientific community can progress towards a preeminent role in consumer decision-making. The method would be required to outweigh the 'lack of time for cooking'-scenario, which is a developing trend in itself [34], and which explains the inflated segments of highly-processed, energy-dense fast foods (e.g. [28]). Besides, dietary guidelines would have to compete with pseudo-scientific mass media slogans (e.g. 'superfoods', the AGE-less way, the Paleo diet). It is questionable how consumers may retain their credence towards established scientific dietary guidelines, since apparently, scientists, as risk assessors, lack the management tools or communication channels to effectively reach the consumer. Better management tools and communication channels may be found within policy-based initiatives and legislation as discussed below.

4. POLICY FOR HEALTH

Our western environment has been described as 'obesogenic', and 'unhealthy', implying that it promotes disease (especially by stimulating a sedentary lifestyle with quick-to-prepare energy-dense meals) [35,36]. To counter the unhealthy environment, policy-makers such as legislators have the means [37], and thus some degree of responsibility [38]. Various governments have enacted measures, such as regulations on frying oils in snack bars [39-41], offerings in school canteens [42,43], food advertising to children [44], and food labelling [45]. With some exceptions [46], the proposed regulations have led to acceptance and success. For example, trans fatty acid levels in Danish fast food were tenfold lower than those in neighbouring countries [47], likely due to the Danish regulation on trans fatty acids.

Several governments have taken responsibility to control the unhealthy environment, and their successes have not gone unnoticed. For

example, based on Danish success, the European Commission and the FDA now consider proposing a regulation on trans fatty acid content in foods (e.g. [48]). This could further reduce the number of cardiovascular events, and health-care costs [49].

Non-legal options to stimulate a healthy environment include the new concept of smart city-design (e.g. parks with fruit and nut trees [50], or community kitchens [51]), and stimulatory programmes (e.g. lowered taxation on vegetables [52], or child breakfast programmes). In summary, large-scale implementation of regulations and smart city initiatives are still to occur, but potential effects are considerable.

5. POLICY FOR SUSTAINABILITY

Policy-makers face new challenges in a rapidly changing world [53-55]. Issues that were tenuous in the 20th century can evolve quickly in the future, by exponential growth [56,57], critical decline [58,59], or *de novo* emergence [60,61]. Several bodies have drawn scenario-based projections of the future. The next section will analyse, for each scenario, the potential role of policy-based dietary guidance.

The scenarios found in refs [62-64] build on current favourable or unfavourable trends, i.e. food prosperity versus food crises, and require appropriate anticipation by policy-makers.

Scenarios of prosperity are characterised by new technologies and innovations (e.g. GMO, *in vitro* meat, food pills, and functional foods), complex global trade systems (which might in turn increase the risk for food safety events), and consumer naivety about food and its effects (abundance of convenience foods, obesity). Consumer demands and industrial innovations drive dietary patterns, while sustainability problems do not come to expression due to technological advances. Thus, given a sustainable food supply, food policy-based dietary guidance is confined to tackling health-related problems.

Scenarios of crisis are characterised by food supply chain risks (antimicrobial resistance, contamination), resource depletion (phosphorus, freshwater, leading to price volatility), or climate change (decreased crop productivity, food pests). Common effects may be: loss of consumer confidence, food resource nationalism, and social unrest. Thus, given an unsustainable

food supply, global food policy-based dietary guidance is required.

6. FOOD INDUSTRY

In an attempt to make food consumption healthful and sustainable, policy-makers face increasing involvement from the food industry [38]. This trend is characterised by the rise of major multinationals [65], especially those with a core business around unhealthy or unsustainable food products. The food industry uses its power to influence science [66,67], the consumer [68,69], and policy-makers [70], and thus the dynamics of dietary guidelines and dietary guidance. At the same time, food industrial entities have launched initiatives to contribute to a healthful [71] and sustainable [72] food consumption, possibly with the purpose of deflecting social and political pressure [73,74]. However, if such initiatives prove financially disadvantageous, one can not expect companies to retain them (e.g. [75,76]. It is unclear whether the food industry can reasonably be expected to be a full partner in the promotion of a healthful and sustainable food consumption. Therefore, the suggestions of the present paper focus on the interplay between science and policy.

7. SUGGESTIONS

The trends and projections analysed in this paper lead to two main conclusions. First, the role of science-based dietary guidelines is unlikely to grow, as 1) most old dietary guidelines have maintained their validity, and thus abrupt improvements are not expected; 2) consumers are prone to short-term influences, such as a lack of time, which renders dietary guidelines impractical. Second, the role of policy-based dietary guidance is likely to grow, as 1) there is a trend of regulations that successfully counter the unhealthy, obesogenic environment; 2) scenarios of crisis require preliminary action, for which policy-makers have the means.

One rigid view pictures scientists practising science, and policy-makers practising politics. Here, scientists can only minimally influence society towards healthy and sustainable nutrition, and, worse, their influence may be incompatible with that of policy-makers.

What if scientists, as well as consumers, would take on a pro-active role towards the political driver's seat, and if dietary guidelines and dietary guidance would coalesce? In that case, dietary

guidelines, set up for individual-health promoting purposes, would be calibrated on global considerations. Dietary guidance, set up for global health and sustainability promoting purposes, would be calibrated on empowering the individual. This vision will be illustrated by suggestions concerning red meat, and self-sufficient local food networks.

7.1 Red Meat

Red meat is a suitable target for dietary guidelines, as it is a burden on both individual health as well as global sustainability [77], and its consumption is booming worldwide, most notably in developing countries [62,78-80]. First, red meat intake is associated with an increased risk for colorectal cancer [81,82], and probably other cancers [83,84] as well as type-II diabetes [85]. Second, producing meat is an unsustainable and inefficient process: it requires a large land surface [86], emits considerable amounts of greenhouse gases [87], and is prone to contamination [88]. On the above grounds, dietary guidelines to reduce red meat consumption can serve as super-scientific tool, with a broad rationale.

Discouraging red meat consumption will likely come with criticisms. First, guidelines on a single food or food category, may, from a merely scientific point of view, be inferior to a "total diet approach" [89,90] (e.g. food pyramids). However, the present paper emphasises, based on trends and empirical data, that considerations for dietary guidelines should not merely be scientific, but also political. The efficacy of the total diet approach is unknown [91-94], and it has been suggested that guidelines should be simple, clear, and specific [95]. Second, substituting red meat for plant-derived foods would reduce protein and fat intakes. However, in the western diet, proteins and fats constitute 16-17 and 33-37% of total energy intake respectively [96-99], which is higher than the WHO recommendations [100]. Third, the meat industry will suffer losses following a reduced demand for red meat, and red meat prices are forecast to rise to levels unaffordable for the lower income groups [6,62]. This type of considerations is inherent to food policy, and requires an assessment of the societal effects, per country. In summary, the example of red meat shows how dietary guidelines can evolve from a purely individualistic, scientific matter to a situation in which scientific (health) and political (health and sustainability) agendas are aligned.

7.2 Self-sufficient Local Food Networks

Self-sufficient local food networks, also termed 'alternative food networks' [101,102], are small-scaled [103] social communities with sustainable food supply chains (i.e. that can operate in a financially independent way, while being ecologically sound [104]), usually including community gardens.

The setup of these networks is a suitable means of dietary guidance, as it addresses both global sustainability as well as individual health. First, it protects against the risks associated with the complexity of global trade. Food safety events [105,106] are unlikely, because supply chains are short, specific, and easily-controlled. Consumer confidence is secured, because consumers are actively involved in the food supply chains as entrepreneurs [62,107-111]. International conflicts, which could jeopardise global trade, would leave local food networks unharmed. Second, self-sufficient local food networks rely largely on plant-derived foods, so that, in its purest form, the obesogenic environment may diminish.

Self-sufficient local food networks are a drastic innovation that comes with a couple of disadvantages. First, the variety of foodstuffs available will be strongly restricted, because the community relies on seasonal, local products [62]. A more homogeneous diet can, in theory, lead to nutrient deficiencies. Complementary innovations are required to diversify food access. Second, not every region is geographically capable of hosting a self-sufficient local food network, notably regions with barren terrain such as deserts, mountainous, and polar areas [103]. It is important to emphasise that such a network does not replace international trade, but rather serves as a sustainable shadow system, that, triggered by high-impact events, can materialise when deemed necessary. In summary, the example of self-sufficient local food networks shows how dietary guidance can evolve from a purely societal, political matter to a situation in which consumers and scientists are empowered.

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